Declaration for the Record of Decision

Site Name and Location

Ott/Story/Cordova Site
North Muskegon, Michigan

Statement of Basis and Purpose

This decision document presents the selected remedial action for Operable Unit 2 the Ott/Story/Cordova site, in North Muskegon, Michigan, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the factual and legal basis for selecting the remedy for this site.

The State of Michigan concurs with the selected remedy. The information supporting this remedial action decision is contained in the administrative record for this site.

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial threat to public health, welfare, or the environment.

Description of the Selected Remedy

This operable unit is the second of three planned operable units for the site.

Operable Unit 1 addressed the contamination of the nearby Little Bear Creek system caused by the influx of contaminated groundwater whose original source of pollutants was the Ott/Story/Cordova site. Operable Unit 2 considers aquifer restoration measures. Operable Unit 3 will consider principal threats as may be posed by contaminated soil areas associated with the site.

While Operable Unit 1 addressed one of the key threats posed by the site, the issue of aquifer restoration was beyond the scope of the Operable Unit 1. Operable Unit 2 will consider that goal to the degree possible. The aquifer below and downgradient of the Ott/Story/Cordova site is contaminated to a significant degree. Full restoration, if possible, is likely to take many years. If full restoration is not possible then containment measures must be implemented for what is now an unknown period of time.

The United States Environmental Protection Agency (U.S. EPA) in consultation with the Michigan Department of Natural Resources (MDNR), will re-evaluate groundwater restoration components of this Record of Decision at least every five years to review whether or not satisfactory progress is being made toward aquifer restoration goals.

The major components of the selected remedy for Operable Unit 2 include the following:

- Installation and operation of extraction wells designed to restore the aquifer and prevent degradation of useable groundwater resources at the southern boundary (downgradient edge) of the plume of contamination.

- Install and operate a purge and treatment system at points in the unconfined and semiconfined aquifer system specifically designed: (1) to halt movement of the contaminated groundwater plume (2) to reduce pollutant mass (3) restore the aquifer to useable conditions (4) to be sufficiently flexible to allow modifications of the design of the purge system based upon operating experience.

- A phased approach will be used for the installation of extraction and monitoring wells to efficiently define the extent of groundwater contamination, and to apply the knowledge gained to effectively demonstrate the capture and treatment of the entire contaminated groundwater plume.

- Installation of a groundwater monitoring system that: (1) demonstrates the effectiveness of restoration (2) demonstrates complete capture of the groundwater plume, (3) identifies the most efficient locations for extraction wells, (4) is capable of determining when the aquifer is sufficiently restored to allow wells to be taken out of service.

- Provide for adequate treatment of groundwater collected such that the resultant discharge will meet substantive effluent limitations as determined by the authorized State of Michigan program.

Declaration of Statutory Determinations

The selected remedy for Operable Unit 2 is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and it satisfies the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as their principal element.

The United States Environmental Protection Agency (U.S. EPA) will re-evaluate this remedy to determine whether health-based levels can be attained throughout the aquifer. If a determination is made that any portion of the aquifer cannot be restored, then containment measures must be employed to avoid contamination of downgradient areas.

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Valdas V. Adamkus
Regional Administrator
U.S. EPA - Region V

9/29/90.
Date

DECISION SUMMARY FOR THE RECORD OF DECISION

1. SITE NAME, LOCATION, AND DESCRIPTION

The Ott/Story/Cordova site is located in Dalton Township, Muskegon County, Michigan, approximately five miles north of the City of Muskegon (see Figure 1). The site is in what may be termed the northernmost vicinity of the Greater Muskegon area.

A point of concern with regard to the site is the proximity of residential areas. Such areas exist in the form of a trailer park slightly northwest of the site, and some 100 homes located in vicinities shown to be downgradient of the site along Central, River, and Russell Roads. These homes are within a mile of the site.

The Ott/Story/Cordova site is at the headwaters of a small unnamed tributary of Little Bear Creek, which flows southeast of the site approximately one-half mile away. It is unlikely that Little Bear Creek serves as the regional groundwater discharge point. That point is more likely the Muskegon River, some three miles to the south.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Site operations began approximately in 1957. The site has been owned by various specialty organic chemical manufacturers. Products made over the span of active operations included intermediate items used in the making of pharmaceuticals, dyestuffs, agricultural chemicals, diisocyanates, herbicides, etc.

For at least ten years, production vessel clean-out wastes and wastewaters were all initially discharged to on-site unlined lagoons and allowed to dissipate into soils by seepage. Later, accumulation of large numbers of drums of waste occured.

By the early 1960s, signs of water and soil contamination were beginning to be noted. Later, in response to Michigan concerns, efforts were made by the site owners to slow the spread of the groundwater contaminant plume emanating from the site. Correspondence by some members of the Michigan Water Resources Commission and later the Michigan Department of Natural Resources (MDNR) expressed concern as to the effectiveness of such efforts.

By 1977, with the then present site owner (Story Chemical) in bankruptcy, a removal action was undertaken by the State of Michigan and financed in part by a new site owner. Several thousand drums and thousands of cubic yards of lagoon sludges were removed and disposed of from the site. During the site's history, various information and documents were filed with

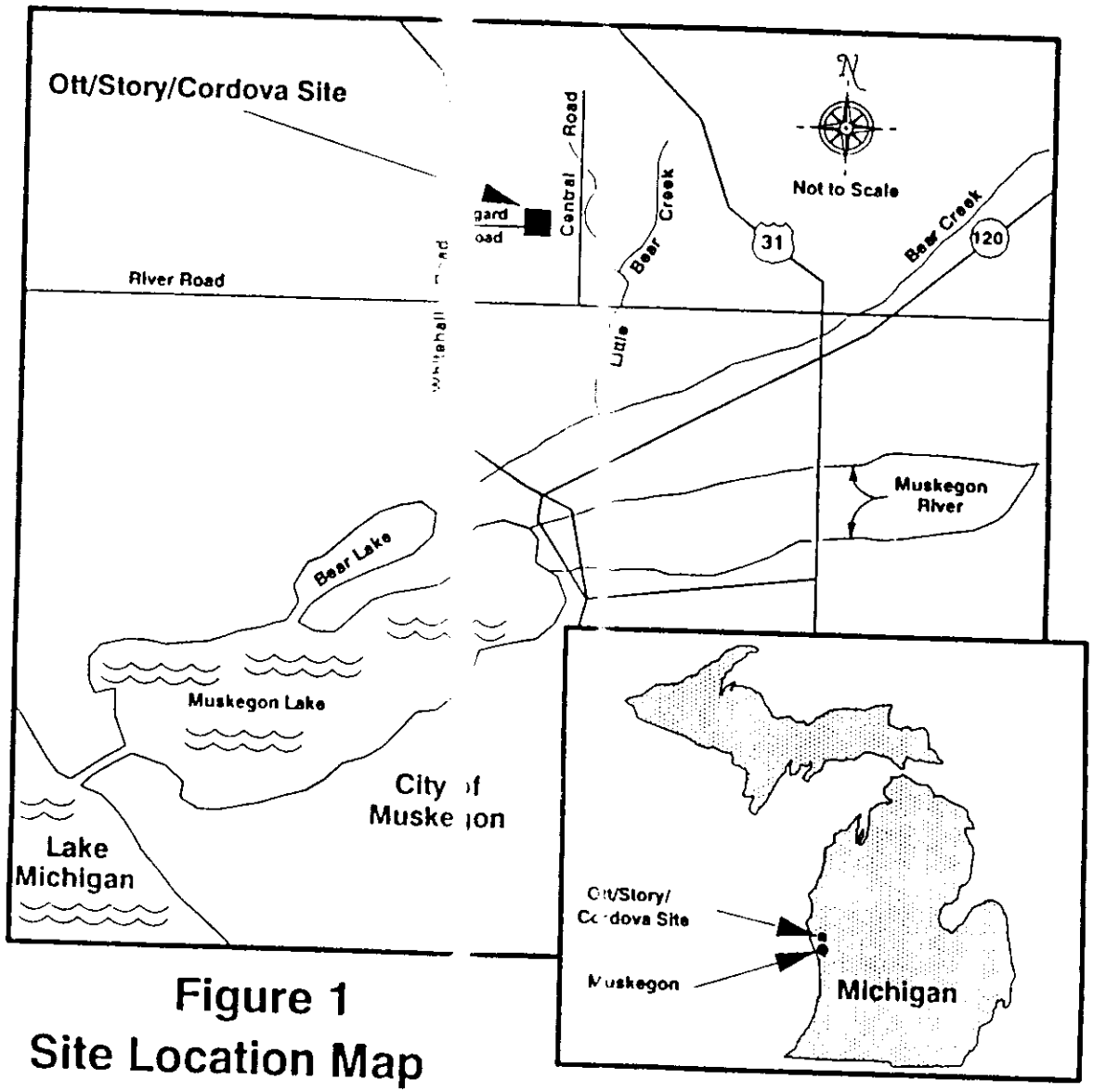


Figure 1
Site Location Map

federal and state governments. Briefly, and in approximate chronological order, these are:

- Information generated by Ott Chemical regarding Michigan Orders of Determination concerning groundwater and lagoon usage (approximately 1965-1966).

- Information generated by Ott and Story Chemical concerning effluent content to waters of the State of Michigan (approximately 1967-1973).

- Information generated by Ott Chemical and submitted to the Corps of Engineers regarding the River and Harbors Act, (a forerunner of the National Pollutant Discharge Elimination System) (approximately 1971).

- Filing for generator status and treatment/storage permits by Cordova Chemical of Michigan under the Resource Conservation and Recovery Act (approximately 1980).

- Filing by Cordova for various Michigan air permits (early 1980s).

In 1982, the site was placed on the National Priorities List (NPL). Also in 1982, an alternate water supply was undertaken in the vicinity of the site in settlement of a citizens' suit against of former site owner, and financed in part by a former site owner, and in part by the State of Michigan.

Three distinct sets of site owner/operators have been involved in the site over its history. The Ott Chemical Company began operations at the site in the 1950s as an independent company. In 1965, Corn Products Company, now CPC International, purchased all stock of Ott Chemical. In 1972, CPC sold assets that comprised the Ott Chemical operations to Story Chemical. In late 1976-early 1977, Story Chemical initiated bankruptcy proceedings. In late 1977-early 1978, Cordova Chemical Company of Michigan purchased the site after entering into an agreement with the State of Michigan. The agreement called for Cordova to destroy or neutralize phosgene gas left at the site, and to finance in part the State's action to remove drums of waste and lagoon sludges. In return, the State of Michigan agreed to limit Cordova's liability for future site releases caused by past activities. U.S. EPA was not a party to the agreement.

In 1985, a notice letter was sent to Cordova and CPC, potentially responsible parties (PRPs), advising them of their potential liability for the site. The letter offered them an opportunity to conduct a site Remedial Investigation/Feasibility Study (RI/FS). Both CPC and Cordova declined to accept this offer, and U.S. EPA conducted an RI/FS. In March 1989, U.S. EPA also sent demand letters for cost recovery to CPC and Cordova. In May

1989, U.S. EPA also informed Cordova Chemical Co. of California (parent company of Cordova-MI), Aerojet-General (parent company of Cordova of California) and Swanton-Story Corporation (successor of Story Chemical) of their potential liability as regards this site and sent demand letters to these firms. Both Aerojet-General and Swanton-Story Corp. are considered PRPs due to Aerojet's ownership of Cordova Chemical and Swanton-Story being what remains of Story Chemical after the bankruptcy proceedings.

In August 1989, PRPs were given notice pursuant to a Section 122(a) letter that U.S. EPA had determined that a period of negotiations would not facilitate an agreement for remedial design and action for Operable Unit 1. The availability of the Proposed Plan/Focused Feasibility Study, and notice of the start of a public comment period were also stated in the letter. Presently, litigation among the PRPs, the state and federal government is underway. CPC International has filed a suit for its costs against Aerojet, Cordova and the State of Michigan in the U.S. District Court, Western District of Michigan. In October 1989, U.S. EPA filed a cost recovery action in the same federal court.

A ROD for Operable Unit 1 was signed by U.S. EPA in September 1989. However, in November 1989, U.S. EPA reopened public comment on its selected remedy for Operable Unit 1, and declared that it would reconsider the selected remedy. This comment period extended to December 1989. In December 1989, CPC filed a counter claim against U.S. EPA, alleging improper procedure regarding compilation of the Administrative Record supporting Operable Unit 1. Response to this claim was made by U.S. EPA through the U.S. Department of Justice in February 1990.

In March 1990, U.S. EPA affirmed its Record of Decision for Operable Unit 1, and later that same month issued a Unilateral Order pursuant to Section 106 of CERCLA to undertake actions as determined in the Record of Decision. The PRPs chose not to comply with the Order. In June 1990, an Inter-Agency agreement was finalized between the U.S. EPA and the U.S. Army Corps of Engineers, such that remedial design work for Operable Unit 1 could begin.

3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

A RI/FS "Kickoff" availability session was held near the site in November 1987. Upon the completion of the RI in April 1989, a copy of the RI report was made available to the public at the information repositories maintained at the Dalton Township Public Hall and the Walker Memorial Library in North Muskegon. The RI was also made a part of the administrative record file maintained in Region 5 and at the local repository at the Walker Memorial

Library. A Proposed Plan and Focused Feasibility Study for Operable Unit 2 were released to the public on August 1, 1989 to initiate a public comment period for the proposed action. A public meeting was held in August 1989.

The Feasibility Study (FS) and Proposed Plan for Operable Unit 2 were made available to the public in July 1990. A notice of availability was published in the Muskegon Chronicle on July 24, 1990 to initiate a public comment period on the alternatives from July 25, 1990 to August 23, 1990. In addition, a public meeting was held on August 16, 1990 in Muskegon County. At this meeting, representatives from EPA and the Michigan Department of Natural Resources (MDNR) answered questions concerning site conditions, problems, and remedial alternatives under consideration. In response to a request for extension, U.S. EPA subsequently extended the public comment period to September 24, 1990. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision. This decision document presents the selected remedial action for Operable Unit 2 for the Ott/Story/Cordova Site in North Muskegon, Michigan, chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the National Contingency Plan. The decision for this site is based on the administrative record.

4. SCOPE AND ROLE OF OPERABLE UNIT

As with many Superfund sites, the problems at the Ott/Story/Cordova site are complex. Consequently, EPA has organized the remedial work into three planned operable units at the site. This Record of Decision addresses the second operable unit planned for the site.

- Operable Unit 1 focused on the interception of contaminated groundwater entering and degrading the Little Bear Creek system. This action is now in the Remedial Design stage, with construction start-up anticipated for the spring of 1991.

- Operable Unit 2, which is the subject of this Record of Decision, has as its primary goal the restoration of the aquifer system below and downgradient of the Ott/Story/Cordova site.

  The goal of the Operable Unit 1 was to address an immediate threat to human health and the environment, namely the introduction of a portion of the contaminated aquifer system in a surface water body that flows through and near a residential area. The broader question of groundwater remediation will be addressed by this Operable Unit 2.

The National Contingency Plan (NCP) provides guidance on this issue. As stated on page 8732 of the March 8, 1990 "Federal Register," the NCP notes that: the goal of U.S. EPA's Superfund approach is to return usable groundwaters to their beneficial uses within a timeframe that is reasonable given the particular circumstances of the site.

The NCP also provides guidance on the important consideration of reasonable timeframe. The NCP calls for very rapid restoration time periods of groundwater currently used for drinking water supply. More extended timeframes may be appropriate for groundwater with the potential to serve as such a supply.

At the Ott/Story/Cordova site, an alternate water supply was provided in nearby areas downgradient of the site. However, groundwater users do exist approximately 1 and 1/2 miles to the east and south (downgradient) of the site. Therefore, restoration in a reasonable timeframe will be an important consideration of this Record of Decision. The NCP also provides guidance on two other important questions; the role of institutional controls, and whether natural attenuation should be expected to play an important part. On page 8706 of the March 8, 1990 "Federal Register," the NCP notes that institutional controls will usually be used as supplementary protective measures during implementation of groundwater remedies. On page 8734 of this document, the NCP also notes that natural attenuation may be recommended when it is expected to reduce concentration of contaminants in groundwater to remediation levels in a reasonable timeframe. U.S. EPA believes that neither the sole use of institutional controls or dependence on natural attenuation for aquifer restoration are prudent or effective means in remedying the highly contaminated groundwater at the site. Groundwater contamination remains very high presently, even twelve years after the site ceased operation, and available information indicates that concentrations of contaminants will not be reduced without active remediation.

- A third operable unit for the Ott/Story/Cordova site will be developed to consider areas of soil contamination found on site. The FS for Operable Unit 2 explored soil alternatives to the site. However, shortly after the completion of the FS, the State of Michigan promulgated new regulations concerning environmental response, the Act 307 rules. U.S. EPA believes it is appropriate to examine assumptions made in the latest FS concerning projected soil volumes and cleanup levels in light of those new regulations. In addition, U.S EPA plans to conduct further soil/sediment sampling along the banks of Little Bear Creek.

5. SUMMARY OF SITE CHARACTERISTICS

An important site characteristic at Ott/Story/Cordova is the sandy nature of site soils which result in a high permeability. Past usage of unlined waste lagoons and subsequent plant spills/releases have resulted in masssive introduction of pollutants into the soil and groundwater. The RI revealed over 90 different organic compounds in the groundwater, of which 32 are classified as priority pollutants.

The table on the following page presents selected testing results of groundwater monitoring wells at the site. Highly elevated levels of compounds such as 1,2 dichloroethane, 1,1-dichloroethene, vinyl chloride, tetrachloroethene, and benzene exhibit varying degrees of carcinogenic activity. As was dicussed in the RI Report, a contaminant's characteristics such as structure, solubility, and vapor pressure influence its potential to and rate of migration in soils vapor and groundwater.

Compounds such as vinyl chloride and 1,2-dichloroethane may be described as extremely mobile, 1,1-dichloroethene, 1,1,1-trichloroethane, toluene, and xylene as very mobile; and 1,2-dichloro-benzene as slightly mobile.

RESULTS FOR SELECTED TESTING WELLS

(Results given in micrograms per liter or approximately parts per billion)

LOCATION	CONTAMINANTS	HIGHEST CONCENTRATION	MCL
W3	(none detected-background well northwest of site)		
W101S	1,2 Dichloroethane	2200	5
	1,1 Dichloroethene	350	7
	Benzene-3800	3800	5
	Tetrachloroethene	24,000	5
	Toluene	38,000	2000
W101I	1,2 Dichloroethane	110,000	5
	1,1 Dichloroethene	970	7
	Benzene	510	5
W101D	1,2 Dichloroethane	8	5
	Tetrachloroethene	55	5
	Vinyl Chloride	9	2
OW9	1,2 Dichloroethane	21,000	5
	1,1 Dichloroethene	7,900	7
	Vinyl Chloride	50,000	2

OW12	1,2 Dichloroethane	110,000	5
	1,1 Dichloroethene	1,100	7
	Vinyl Chloride	50,000	2
B1	Vinyl Chloride	550	2
OW8	Benzene	15	5
	Vinyl Chloride	7,200	2

At the Ott/Story/Cordova site, soils are predominantly sand to a depth of approximately 65 feet. Then, layers of silts and clays tend to form a barrier separating the upper unconfined aquifer from a lower semiconfined zone which begins at about 85 feet below the ground's surface. All of the samples noted above were taken from the upper sandy aquifer zone, except for well W101D, which is in the lower semi-confined aquifer.

The considerable array of groundwater pollutants shown in the above table yields insight as to the degree of contamination found at the site. The RI shows the presence of intermingled silt and clay layers occurring at a depth of approximately 65-85 feet below the ground surface. Contaminants may be more strongly retained within this interval, and the ability of these layers to slowly release contaminants throughout the groundwater system causes concern over the ability to attain ultimate health-based restoration goals.

The MCL, or maximum contaminant level, helps provide a useful comparison of the sampled groundwater's relative cleanliness or contamination. MCLs are enforceable standards for contaminants in drinking water supply as established by the Safe Drinking Water Act.

Certain monitoring points are worthy of note as regards to Operable Unit 2. Well B1 is considerably west of the Little Bear Creek area, along River Road. Well 101D is just north of Agard Road, and is screened in sandy soil some 120 feet below the ground's surface (see Figure 2). In these cases, interception by wells designed in operable unit 1 to prevent contaminant discharge into Little Bear Creek from the shallow aquifer is open to doubt.

The volume of contaminated groundwater at Ott/Story/Cordova has been estimated at over 1.2 billion gallons. Figures 1 and 2 provide the reader with an approximate idea of site setting, and the location of wells referred to in these discussions.

6. SUMMARY OF SITE RISKS

Numerous chemical compounds were detected during the course of

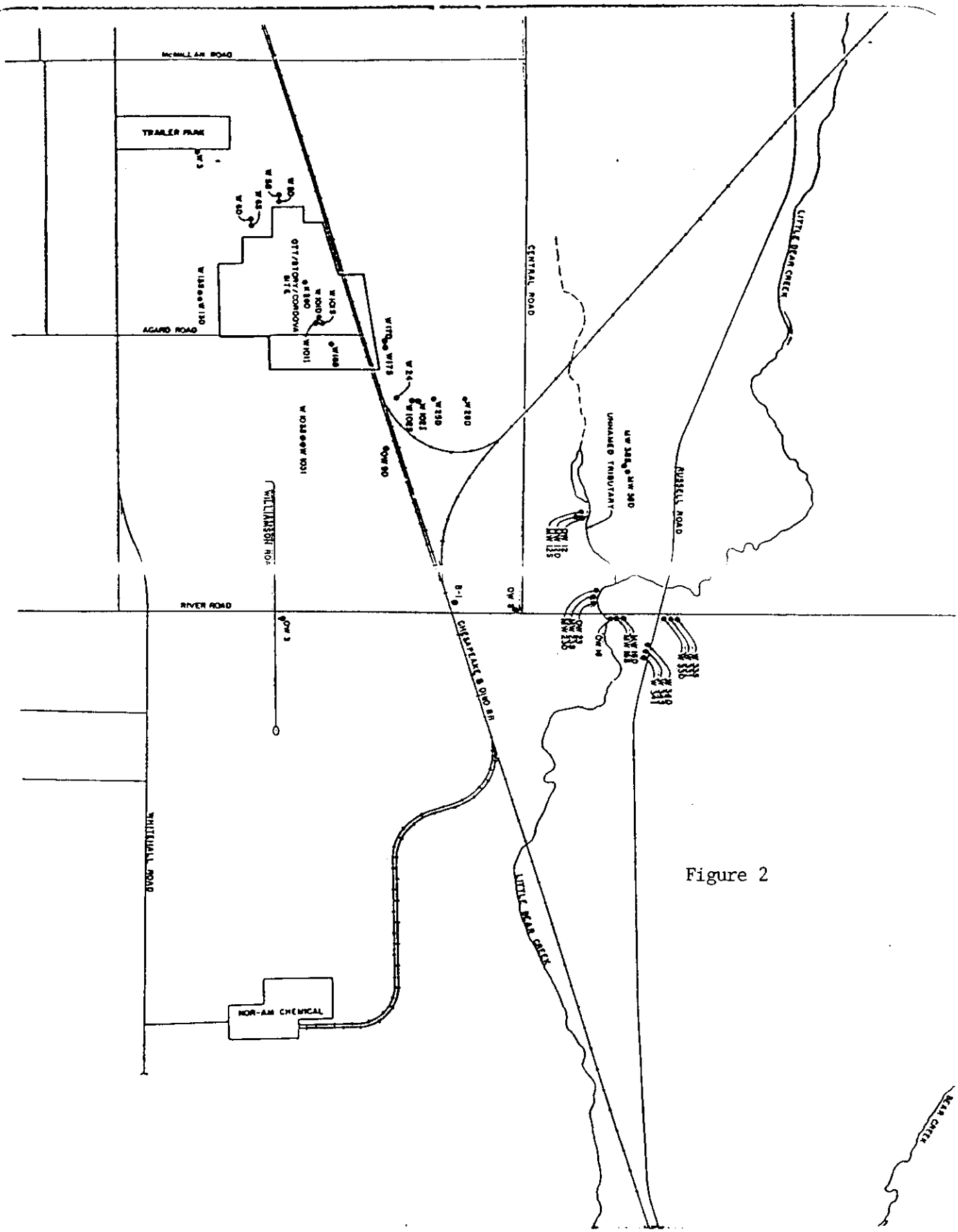
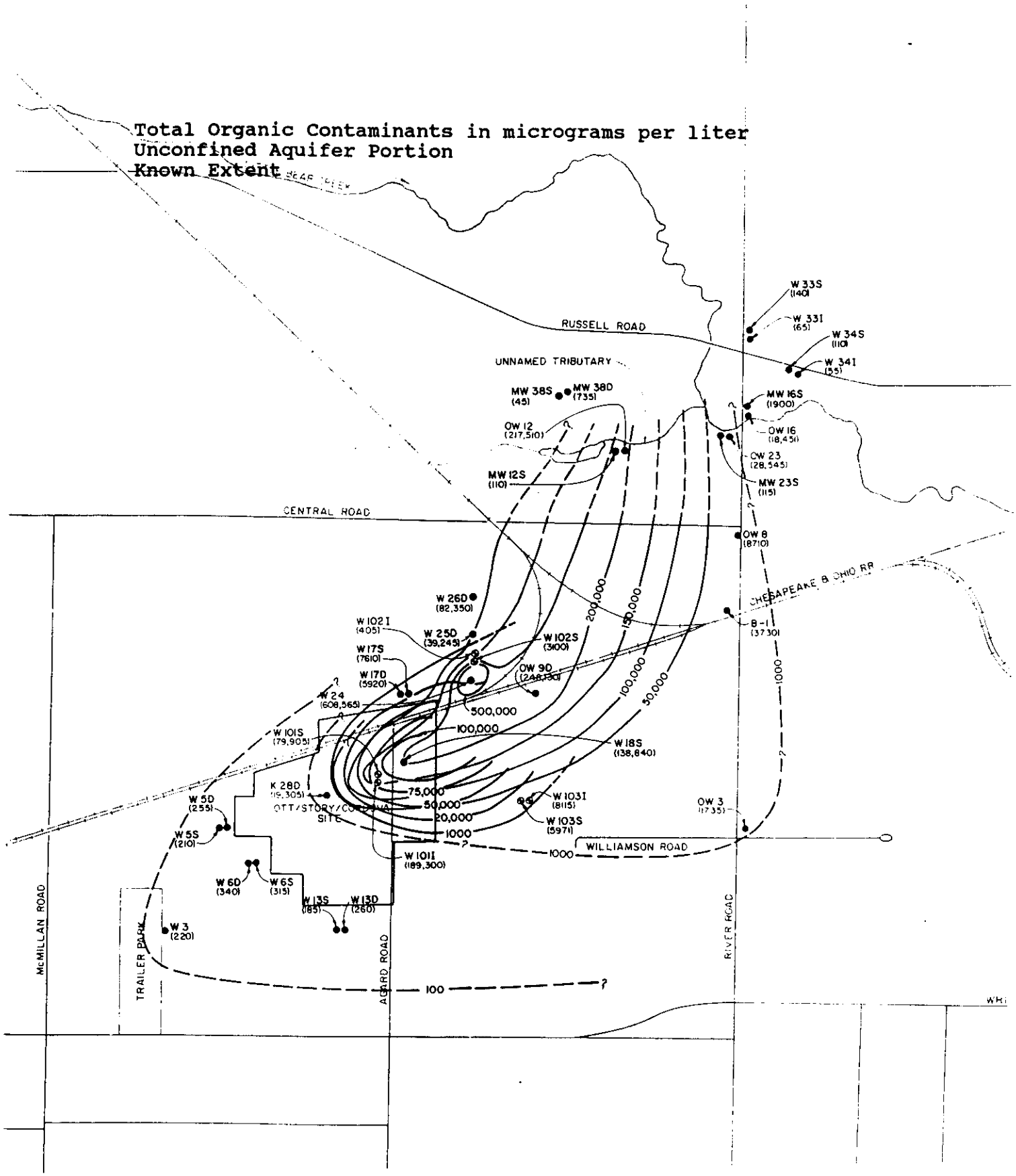

TRAILER PARK
AGARD ROAD
CENTRAL ROAD
RUSSELL ROAD
RIVER ROAD
WILLIAMSBURG RD
CHESAPEAKE & OHIO RR
LITTLE BEAR CREEK
UNNAMED TRIBUTARY
NOR-AM CHEMICAL

Figure 2


Total Organic Contaminants in micrograms per liter
Unconfined Aquifer Portion
Known Extent
BEAR CREEK
RUSSELL ROAD
UNNAMED TRIBUTARY
CENTRAL ROAD
CHESAPEAKE & OHIO RR
WILLIAMSON ROAD
McMILLAN ROAD
TRAILER PARK
AGARD ROAD
RIVER ROAD
OTT/STORY/CORDOVA SITE
W 33S (140)
W 331 (65)
W 34S (110)
W 341 (55)
MW 38S (45)
MW 38D (735)
MW 16S (1900)
OW 12 (217,510)
OW 16 (18,451)
OW 23 (28,545)
MW 12S (110)
MW 23S (115)
OW 8 (8710)
W 26D (82,350)
W 102I (405)
W 25D (39,245)
W 102S (3100)
W 17S (7610)
W 17D (5920)
OW 90 (248,750)
W 24 (608,565)
W 101S (79,905)
W 18S (138,840)
K 28D (19,305)
W 5D (255)
W 5S (210)
W 6D (340)
W 6S (315)
W 13S (185)
W 13D (260)
W 3 (220)
W 1011 (189,300)
W 1031 (8115)
W 103S (5971)
OW 3 (17,35)
B-1 (3730)
500,000
200,000
150,000
100,000
75,000
50,000
30,000
20,000
1000
100

Ott/Story/ Cordova field investigations. As is explained in further detail in the RI report, some 90 organic compounds were detected in groundwater, and over 200 organic compounds were detected in site soil samples. Inorganic compounds were also detected in both soils and groundwater. Data sets were evaluated to consider those chemicals above background levels, toxicity constants for noncarginogens and carcinogens were reviewed, and the degree of occurrence of a given substance at the site was considered.

As discused in the NCP, a baseline risk assessment is initiated as a part of remedial investigation. The purpose is to determine whether the contaminants found pose a current or potential risk to human health and the environment in the absence of remedial action. Such assessment helps provide a basis to determine if remedial action is necessary. The assessment consists of exposure and toxicity components combined so as to characterize overall risk.

Based on this evaluation, twenty-two indicator chemicals were selected at the Ott/Story/Cordova site which appeared to not only be present in significant concentrations, but also exhibit the potential for relatively high toxicity. These substances are:

1,1,2-trichloroethane	benzene	silver
1,2-dichloroethane	heptachlor epoxide	barium
1,1-dichloroethene	xylene	zinc
trichloroethene	toluene	copper
carbon tetrachloride	4,4'-DDT	nickel
vinyl chloride	PCB	cyanide
chloroform	dichloromethane	arsenic
tetrachloroethene		

EXPOSURE ASSESSMENT

During early production periods at the site, releases of contaminants occurred either to the air or soil. Since production activities have now been curtailed, it is assumed that all present releases from the site resulted from previous releases to soil.

Once in soil, further releases can occur by movement of contaminants into groundwater and the subsequent discharge to surface water, volatilization into the air or suspension of contaminated dusts into the air, or runoff of surface water that may carry contaminated soils.

The movement of contaminated groundwater results in several exposure pathways. Users of groundwater are considered a potentially exposed population. Formerly, several residents near the site were supplied by individual groundwater wells. In 1982, as a result of a settlement of a citizens' suit against one of

the PRPs, an extension of an alternate water supply to the area was provided. Beyond this supply extension, groundwater is used as a water supply. In recent years, the Muskegon County Health Department has found it necessary to warn residents near the site not to use groundwater for watering lawns or gardens; such usage can present a direct ingestion or inhalation pathway. The groundwater at Ott/Story/Cordova may be classified as a Class II supply, as discussed in the NCP on page 8732 of the March 8, 1990 "Federal Register." Prior to the present contamination, the aquifer below and downgradient of the site served as a source of drinking water.

Operable Unit 2 will address the primary exposure scenario posed by contaminated groundwater. This scenario concerns ingestion by potential groundwater users.

TOXICITY ASSESSMENT

The degree of toxicity which may be posed by a given chemical may be described in part by its acceptable intake for subchronic exposure (AIS), its reference dose or acceptable intake for chronic exposure (AIC), and in the case of carcinogens by its carcinogenic potency factor. Values for AIS and AIC are derived from information available from studies on animals or human epidemiologic studies. These values are normally reported in mg/kg body weight/day, and generally represent the highest calculated exposure level below which the given adverse effect will not occur. A carcinogenic potency factor is expressed as lifetime cancer risk per mg/kg body weight/day, and is estimated at the upper 95 percent confidence limit of the carcinogenic potency of a given chemical.

Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of (mg/kg-day)-1, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies of chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are

expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

The following two tables describe AIC, AIS, and carcinogenic potency factors for indicator chemicals at the Ott/Story/Cordova site. The third table lists the weight of evidence for the various categories of potential carcinogens.

RISK CHARACTERIZATION

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1x10-6 or 1E-6). An excess lifetime cancer risk of 1x10-6 indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (or the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

The Agency considers excess cancer risk in the range of 10-4 to 10-6 as protective of human health. The risk level of 10-6, which represents a probability of one in one million that an individual could contract cancer under the conditions of exposure, is often used as a "benchmark" of protection. Given the large number of carcinogenic contaminants found in site groundwater, the Agency has determined that for groundwater cleanup a risk level of 10-6 is appropriate for this site for a given contaminant, such that cumulative excess cancer risk does not exceed the 10-4 level.

Risks to future potential ground water users were calculated. Because contaminants in the aquifer are not uniformly distributed, risks were estimated assuming that a given

AIC AND AIS VALUES FOR INDICATOR
CHEMICALS AT THE OTT/STORY/CORDOVA SITE

	Acceptable Intake			
	Ingestion Route		Inhalation Route	
Indicator Chemical	Subchronic (AIS) mg/kg/day	Chronic (AIC) mg/kg/day	Subchronic (AIS) mg/kg/day	Chronic (AIC) mg/kg/day
1,2-Dichloroethane				
1,1-Dichloroethene		0.009		
Arsenic				
Carbon Tetrachloride		0.0007a		
Vinyl Chloride				
Chloroform		0.01		
Tetrachloroethene		0.01a		
Benzene				
1,1,2-Trichloroethane		0.004a		
Heptachlor Epoxide		0.000013a		
Silver		0.003		
Barium		0.05a	0.0014	0.00014
Zinc	0.21	0.21	0.1	0.01
Copper	0.037	0.037		
Nickel	0.02	0.02a		
Trichloroethene				
toluene	0.43	0.30	1.5	1.5
Cyanide		0.02		
Methylene chloride		0.06		
Xylene	0.1	2a	0.69	0.4
PCB				

Primary Source: USEPA, 1986a

a - Source: RfD; EPA IRIS database (12/1/88)

CARCINOGEN POTENCY FACTORS FOR INDICATOR CHEMICALS AT THE OTT/STORY/CORDOVA SITE

Indicator Chemical	Ingestion Route		Inhalation Route	
	Potency Factor $(mg/kg/d)^{-1}$	EPA Weight of Evidence	Potency Factor $(mg/kg/d)^{-1}$	EPA Weight of Evidence
1,2-Dichloroethane	0.091	B2	0.091a	B2
1,1-Dichloroethene	0.58	C	1.16	C
Arsenic	1.65b	A	15a	A
Carbon tetrachloride	0.13	B2	0.13a	B2
Vinyl Chloride	2.3	A	0.295a	A
Chloroform	0.0061a	B2	0.081a	B2
Tetrachloroethene	0.051	B2	0.0033a	B2
Benzene	0.029a	A	0.029a	A
1,1,2-Trichloroethane	0.0573	C	0.057a	C
Heptachlor Epoxide	9.1	B2	9.1	B2
Silver				
Barium				
Zinc				
Copper				
Nickel		A	1.19	A
Trichloroethene	0.011	B2	0.013a	B2
Toluene				
Cyanide				
Methylene chloride	0.0075	B2	0.0143	B2
Xylene				
[illegible]	[illegible]	[illegible]		B2
PCB	7.7	B2		B2

Primary Source: EPA, 1986
a - Source: RfD; EPA IRIS database (revised 12/1/88)
b - USEPA, 1987

EPA WEIGHT OF EVIDENCE
CATEGORIES FOR POTENTIAL CARCINOGENS

EPA Category	Description of Group	Description of Evidence
Group A	Human Carcinogen	Sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer
Group B1	Probable Human Carcinogen	Limited evidence of carcinogenicity in humans from epidemiologic studies
Group B2	Probable Human Carcinogen	Sufficient evidence of carcinogenicity in animals, inadequate evidence of carcinogenicity in humans
Group C	Possible Human Carcinogen	Limited evidence of carcinogenicity in animals
Group D	Not Classified	Inadequate evidence of carcinogenicity in animals
Group E	No Evidence of Carcinogenicity in Humans	No evidence of carcinogenicity in at least two adequate animal tests or in both epidemiologic and animal studies

monitoring well served as a water supply source. Chronic hazard index values and base case cancer risks were estimated for indicator chemicals found in each well.

The chronic hazard index value exceeded unity in 19 monitoring wells. Consequently, were groundwater used in its present state, there is a health risk with regard to noncarcinogenic chemicals.

With regard to carcinogenic indicator chemicals, cancer risks for at least one compound exceeded 1 x 10-6 in 22 wells. Particularly striking were results obtained in monitoring wells OW12 and OW9. Vinyl chloride concentrations in these wells were found to be at such levels that the excess cancer risk from this compound alone was found to approach 1. Eight other wells exhibited instances of either vinyl chloride or 1,2-dichloroethane exceeding cancer risks of 1 x 10-1. It is important to consider risk associated with groundwater ingestion at points in the aquifer system unlikely to be influenced by remedial action of the Operable Unit 1.

Deep well W101D is located north of Agard Road, on the grounds of the former plant. Additive excess cancer risk at this point is approximately 9x10-4, primarily from 1,2-dichloroethane, vinyl chloride, and tetrachloroethene. Well W101D is screened within the deeper semiconfined aquifer portion. Well W101I, noted earlier, is located nearby and is screened in the unconfined aquifer.

Monitoring wells B1 and OW8 are both screened in the unconfined aquifer zone and are located along River Road near the intersections with the C & O railroad tracks and Central Road, respectively. Primarily due to the known human carcinogen vinyl chloride, excess cancer risk associated with groundwater ingestion at well B1 is 4X10-2; at well OW8 such risk is in excess of 1X10-1. These points are sufficiently west of Little Bear Creek that interception by extraction wells serving the Operable Unit 1 is open to question.

These results indicate that any potential ingestion of groundwater from certain areas at the Ott/Story/Cordova site poses enormous health risks. The above discussions indicate that the risks from current and potential exposure to contaminated groundwater are unacceptable. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Uncertainly associated with site risk concerns to what degree contaminated groundwater is used for washing and watering purposes, despite County warning to avoid such usage.

7. DESCRIPTION OF ALTERNATIVES

The alternatives analyzed for Operable Unit 2 are presented below. As was indicated above, these alternative only pertain to the final groundwater remedy.

Alternative 1:	No Action
Alternative 2:	Institutional Control
Alternative 3a:	Supplementary Extraction in only the Shallower Aquifer Portion, Monitoring, Deed Restriction, Physical-Chemical Treatment, Biological Treatment, Stream Discharge
Alternative 3b:	Supplementary Extraction in both Shallow and Deep Aquifer Portions, Monitoring, Deed Restriction, Physical-Chemical Treatment, Biological Treatment, Stream Discharge
Alternative 3c:	Phased Supplementary Extraction in both Shallow and Deep Aquifer Portions, Monitoring, Deed Restriction, Physical-Chemical Treatment, Biological Treatment, Stream Discharge

Common Elements. Except for the "No Action" alternative, other alternatives noted have certain elements in common. All envision that usage of this portion of the aquifer in its current degraded state will be restricted, either indefinitely (Alternative 2) or for the duration of the treatment period (Alternative 3a, 3b, 3c). U.S. EPA presumes development of a deed restriction with the current site owner, and cooperation with other private citizens. The Michigan Department of Public Health advises U.S. EPA that restrictions for residential wells in Muskegon County may not be enforceable. All envision that monitoring of groundwater contaminant levels and movement will be conducted. Alternatives 3a, 3b, and 3c envision employment of identical treatment schemes, which in concept are identical to that employed for the Operable Unit 1. (U.S. EPA notes that remedial design activity for the Operable Unit 1 is underway, and that U.S. EPA has recently approved a work plan for the treatability study of expected removal efficiencies from certain treatment components to be performed concurrently with remedial design.) It is not anticipated that the RCRA Land Disposal Restrictions are ARARs for any of the alternatives discussed above, since the waste are not listed wastes. Any residuals created through Alternatives 3a, 3b, or 3c must be managed properly.

Alternative 1 - No Action

U.S. EPA is required to consider a no-action alternative pursuant to the NCP. This alternative serves as a baseline for comparison purposes. Under this alternative, U.S. EPA would take no additional remedial action at the site to monitor, control, collect, treat, or otherwise cleanup contaminated groundwater. The cost of this alternative is therefore zero.

Alternative 2-Institutional Controls and Monitoring.

Institutional controls, such as deed restrictions, would be implemented under this alternative, restricting current and future uses of ground water at and downgradient of the facility. Additional ground water monitoring wells would be placed in both the unconfined and semi-confined ground water systems to evaluate the southern extent of contamination and provide a basis for placement of deed restrictions. Alternative 2 relies solely on institutional control and a monitoring well network as a means of precluding public usage of contaminated groundwater. U.S. EPA believes that institutional control has a role to play, but should not be relied on solely where engineering controls and treatment are practicable as is the case for the Ott/Story/Cordova site.

Capital Cost: $0.3 million
Present Worth: $1.3 million
Annual O & M: $0.06 million
Time to Implement: 4-5 months

Alternative 3a - Supplmentary Extraction, Monitoring, Usage Restriction, Physical-Chemical Treatment, Biological Treatment, Stream Discharge.

Supplementary extraction wells would be installed only in the shallow aquifer systems, primarily along the southern edge of contaminated groundwater areas. Primary ARARs that will be met by this alternative include the Safe Drinking Water Act for this portion of the aquifer, effluent limitations as administered by Michigan for stream discharge, air emission and waste management regulations. Design life of this, and other restoration groundwater alternatives, is estimated at 30 years.

Physical-chemical treatment will provide initial removal of organic contaminants. Biological treatment will yield enhanced removal of organics prior to stream discharge. Coupled with filtration and adsorption techniques, further contaminant and suspended solids removal will occur.

The specific types of physical-chemical treatment (e.g. UV-

oxidation, air stripping), biological treatment (e.g. activated sludge), and filtration\adsorption (e.g. granular activated carbon), will be determined in the Remedial Design phase through engineering design and analysis.

Capital Cost: $6.4 million
Present Worth: $26 million
Annual O & M: $1.2 million
Time to Implement: 22-24 months

Alternative 3b - Supplementary Extraction, Monitoring, Usage Restriction, Physical-Chemical Treatment, Biological Treatment, Stream Discharge

Supplementary extraction wells would be installed as noted in alternative 3a, and additional extraction wells would be installed near points of higher contamination levels in both the shallow and deeper zones of the aquifer. Requirements to be met for this alternative are as noted for Alternative 3a. This alternative contemplates the installation of an extensive groundwater extraction system that assumes worst case in terms of magnitude and extent of groundwater contamination. Treatment of extracted groundwater would proceed as described in 3a, above.

Capital Cost: $8.9 million
Present Worth: $40.3 million
Annual O & M: $1.9 million
Time to Implement 25 months

Alternative 3c - (Phased) Supplementary Extraction, Monitoring, Usage Restriction, Physical-Chemical Treatment, Biological Treatment, Stream Discharge

Supplementary extraction wells would be installed in both shallow and deeper zones of the aquifer such that, in conjunction with the Operable Unit 1 all known areas of contaminated groundwater would be addressed. Alternative 3c differs from alternative 3b in that it adopts a phased approach to aquifer restoration. This alternative would have the extraction system installed in incremental steps based on the actual extent and magnitude of groundwater contamination. Treatment of extracted groundwater would proceed as described in 3a, above.

Capital Cost: $6 million
Present Worth: $26 million
Annual O & M: $1.4 million
Time to Implement: 22-24 months

8. Summary of Comparative Analysis of Alternatives

A detailed analysis was performed on the alternatives developed in the FS.

The nine evaluation criteria utilized in accordance with the NCP are: overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; state acceptance; and community acceptance.

These criteria are defined below:

- Overall protection of human health and the environment: addresses whether a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls;

- Compliance with ARARs: addresses whether a remedy will meet all of the applicable or relevant and appropriate Federal and State environmental laws and/or justifies use of a waiver.

- Long-term effectiveness and permanence: addressess the expected residual risk and the ability to maintain reliable protection of human health and the environment over time, once clean-up goals have been met;

- Reduction of toxicity, mobility, or volume through treatment: addresses the anticipated performance of the treatment technologies the remedy may employ;

- Short-term effectiveness: addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period (i.e., until clean-up goals are achieved);

- Implementability: addresses the technical and administrative feasibilty of a remedy, including the availability of materials and services needed to implement a particular option; and

- Cost: addresses the estimated capital and O & M costs, as well as a present-worth.

- State agency acceptance: addresses the support agency's comments and concerns.

- Community acceptance: addresses the public's comments on and concerns about the Proposed Plan and RI/FS report. (The

specific response to public comments are addressed in the Responsiveness Summary section of the ROD).

The following is a summary of the comparison of each alternative's strength and weakness with respect to the nine evaluation criteria:

Overall Protection of Human Health and the Environment

Unlike certain other criteria, a remedy is either deemed protective or it is not. There are not "degrees" of protection. Only those alternatives determined to be protective will be considered for the selected remedial alternative.

Alternatives 3b and 3c which call for supplementary extraction and treatment of contaminated groundwater in both shallow and deep aquifer zones to health-based standards offer protection of human health and the environment. Alternative 3a envisions supplementary extraction and treatment only in the shallower zone of groundwater, and allows the deeper aquifer to remain contaminated. Alternatives 1 and 2 do nothing to abate the movement of contaminated groundwater areas which as discussed previously in this document cannot logically be expected to be contained by extraction wells serving Operable Unit 1. Alternatives 1 and 2 are not protective of human health and the environment because they may permit spread of contamination into areas where future well users may be adversely affected.

Compliance with ARARs

This criterion, as with the protectiveness criteron, must be met for an altnerative to be a selected remedy (unless one of the six waivers allowed under the statute is appropriate).

A table of all known site-specific federal and state ARARs and to-be-considered information is provided below. Key ARARs for each alternative have been noted in Section 7 of this document. Each alternative carries its own set of criteria that must be met before implementation of that alternative can be termed to be compliant.

Alternative 3a, 3b, and 3c would meet their respective applicable or relevant and appropriate requirements of federal/state environmental laws and regulations. The preferred (3c) alternative would comply with the Clean Air Act and pertinent Michigan regulations on dust and volatile emissons control, RCRA regulations on proper residuals management, the Michigan-administered Pollutant Discharge Elimination System, the Safe Drinking Water Act, and Michigan Act No. 307

TABLE OF FEDERAL ARARs

- Safe Drinking Water Act (SDWA), 42 U.S.C. 300f: Establishes criteria for drinking water quality. Chemical specific, regarding alternatives 3a, 3b, 3c.

- Clean Water Act (CWA), 33 U.S.C. 1251: Establishes effluent guidelines and water quality criteria. Chemical specific, regarding alternatives 3a, 3b, 3c.

- National Pollutant Discharge Elimination System (NPDES) Program; 40 CFR Parts 122,125 and Subchapter N: Regulates the discharge of water into surface water. (CWA Section 402). Chemical specific, regarding alternatives 3a, 3b, 3c.

- Federal Standards for Toxic Pollutant Effluent; 40 CFR Part 129: Regulates the discharge of certain pllutants. Chemical specific, regarding alternatives 3a, 3b, 3c.

- Fresh Water Quality Criteria (FWQC): Regulates surface water discharge from site. Chemical specific, regarding alternatives 3a, 3b, 3c.

- Clean Air Act and National Ambient Air Quality Standards (CAA and NAAQS), 40 CFR Part 50: Regulates site emissions including particulates during on-site excavation. Action-specific, regarding alternatives 3a, 3b, 3c.

- 40 C.F.R. Part 50; EPA Regulations on National Primary and Secondary Ambient Air Quality Standards (NAAQS). Action-specific, regarding design of treatment for alternatives 3a, 3b, 3c.

Note: An ARAR for an on-site incinerator, air stripper for groundwater treatment or soils treatment units. Used to establish units for air emission based upon modeling. The NAAQS specify the maximum concentration of a federally regulated air pollutant (i.e., SO , particulate matter (PM), NO , CO, ozone, and lead) in an area resulting from all sources of that pollutant.

- 40 C.F.R. 125, Subpart A; EPA regulations on Criteria on Standards for the NPDES, Criteria and Standards for Technology-Based Treatment Requirements in Permits.

Note: An ARAR because it sets out applicability of technology based treatment requirements for discharges of certain pollutants. Section 125.3(c) establishes methods for determining technology based limits.
Action-specific, regarding alternatives 3a, 3b, 3c.

- 40 C.F.R. 125, Subpart K; Criteria and Standards for Best Management Practices.

Note: An ARAR because it requires implementation of best management practices requirements in substantive permits to prevent release of toxic constituents. Chemical-specific, regarding alternatives 3a, 3b, 3c.

- Safe Drinking Water Act; 42 U.S.C. 300

40 C.F.R. Part 141; EPA National Primary Drinking Water Standards; Maximum Contaminant Levels (MCLs).

This standard is an ARAR since the aquifer is potentially usable as a drinking water source. Chemical-specific; alternatives 1,2,3a,3b,3c. (Alternatives 1 and 2 make no attempt at compliance.)

- Resource Conservation and Recovery Act (RCRA) of 1976, as amended by the Hazardous Solid Waste Amendments (HSWA) of 1984, 42 U.S.C. 6901. Regulates disposal of solid waste and the generation, transport, storage, treatment and disposal of hazardous wastes.

Action-specific, regarding alternatives 3a, 3b, 3c since via treatment processes sludges/residuals will be created which will require proper management.

- Executive Order (EO) for Wetlands (11990) and Floodplains (11988) as implemented by EPA's August 6, 1985, Policy on Floodplains and Wetlands assessments for CERCLA Actions: Regulates remedial action implementation in wetlands or floodplains. Location-specific regarding alternatives 2, 3a, 3b, 3c.

- 40 C.F.R. 122, R122.41; EPA NPDES Permit Regulations, Conditions Applicable to all Permits.

Note: Administrative procedural requirements are not ARARs if remedial action is undertaken on-site under CERCLA. A substantive technical requirement to ensure compliance with technical discharge standards including monitoring, record keeping and notification of noncompliance with discharge standards would be an ARAR. U.S. EPA believes actions envisioned by alternatives 3a, 3b, 3c constitute on-site response.

TABLE OF STATE ARARs

- Michigan Water Resources Act, Public Act 245 of 1929, as Amended (Water Resources Commission General Rules, Part 4, 21): establishes surface water and groundwter quality discharge standards and monitoring requirements. Provides ground water criteria for CERCLA sites, landfills and discharges to surface water. Implements NPDES regulations.

- Michigan Air Pollution Act, Public Act 348 of 1965, as Amended: Regulates air quality in the presence of new or modified air sources. Action-specific, pending design of volatile organics in 3a, 3b, 3c.

- Mineral Well Act, Public Act 315 of 1969: Dictates that the proper procedures for installing and abandoning monitoring wells are adhered to. Action-specific for alternatives 1, 2, 3a, 3b, 3c. (Note: Alternative 1 would fail to comply.)

- 40 C.F.R. 262; Regulations for Hazardous Waste Generators

Michigan Hazardous Waste Management Rules, Part 3, R299.9301 to 9309; "Generators of Hazardous Wastes."

Note: This is an ARAR if CERCLA site materials are shipped off-site to RCRA treatment, storage or disposal (TSD) facility. Chemical-specific, pending analysis of sludges/residuals from alternatives 3a, 3b, 3c. Michigan has an authorized hazardous waste program with substantively identical requirements to 40 C.F.R. 262-265.

40 C.F.R. 264, Subpart C; Preparedness and Prevention.

This regulation requires written records of waste management operations. This is an ARAR if CERCLA site materials are shipped to a RCRA TSD facility. Chemical-specific, pending analysis of treatment residuals for alternatives 3a, 3b, 3c.

40 C.F.R. 264, Subpart F; Ground Water Protection.

- Michigan Hazardous Waste Management Rules.

Note: Provides requirements to detect and respond to releases in an aquifer. An ARAR for post-closure detection monitoring after remediation where constituents remain on-site. Chemical-specific, pending selection of treatment reagents for alternatives 3a, 3b, 3c.

- Part 4, Rule 57; Acute Toxicity, Chronic Toxicity, Etc.

  Note: An ARAR because it provides requirement that surface water must not be toxic to aquatic life (except in small zones to initial dilution at discharge points.) Not an ARAR if wastewater is discharged to a POTW. Chemical-specific, POTW discharge not contemplated for alternatives 3a, 3b, 3c.

- Michigan Safe Drinking Water Act; Michigan Public Act 399

  Note: Act 399 is an ARAR because although a "public drinking water supply system" as defined under the Act does not or may not currently exist at or near the site, ground water could potentially be used as a drinking water source in the future. Action-specific for alternatives 1, 2, 3a, 3b, 3c.

- Part 7, R336.1702; New Sources of VOC Emissions.

  Note: This is an ARAR for new sources of VOC emissions for new remedial action. Any person responsible for any new source of VOC emisssions shall not cause or allow the emission of VOC emissions from the new source to exceed the lowest maximum allowable emission rates. A design consideration for alternatives 3a, 3b, 3c since volatile organics make up a substantial portion of groundwater pollutants, and transfer from groundwater to air without proper treatment not appropriate.

- Michigan Environmental Response Act; Act No. 307

The substantive provisions of Parts 6 and 7 of the rules promulgated under the Michigan Environmental Response Act (Act 307) are considered to be an ARAR for the remedial action to be undertaken at this site. These rules provide, inter alia that remedial action be protective of human health, safety, and the environment, (Rule 299.5705(1)). The rules specify that this standard is achieved by a degree of cleanup which conforms to one or more of three cleanup types; a type A cleanup generally achieves cleanup to background (Rule 299.5707); a type B cleanup meets specified risk-based levels in a given media (Rule 299.5709); and a type C cleanup is based on a site-specific risk assessment which considers specified criteria. U.S. EPA has determined that the selected remedy meets the criteria for a type B cleanup of the groundwater. The State has identified Act 245 as an ARAR. U.S. EPA disagrees that Act 245 as interpreted and applied by the State, is an ARAR. Nonetheless, it is the State's judgement that the selected remedial action for this site will provide for attainment of all ARARs including the Michigan Water Resources Act and Part 22 rules. The remedial action will halt the migration of contaminated groundwater and restore the aquifer

to a usable condition. The purged water will be treated prior to discharge.

Long-Term Effectiveness and Permanence

This criterion focuses on any residual risk remaining at the site after the completion of the remedial action. The criterion assesses the adequacy and reliability of any controls used to manage hazardous substances remaining at the site. Unlike the criterion of protectiveness, it is possible to consider effectiveness in terms of degree of permanence.

Alternatives 3a, 3b, and 3c provide a superior degree of permanence compared to alternatives 1 and 2, in that the contaminants within the aquifer system will be extracted and given treatment. Further, both 3b and 3c are superior to 3a because they allow for the treatment of aquifer portions which cannot be addressed satisfactorily by 3a or Operable Unit 1. While the ability to fully restore all portions of the aquifer now contaminated is not certain, alternatives 3a, 3b, and 3c clearly offer an enhanced opportunity to meet cleanup goals than with alternatives 1 or 2.

Alternatives 3b and 3c meet this criterion through pumping and treating contaminated groundwater in an effort to mitigate off-site migration of contaminated groundwater and return the aquifer to its beneficial use. Alternative 3a may not be as effective in in the long term in that the uncertainty in its ability to capture all the contaminated groundwater is much greater than Alternatives 3b and 3c.

Reduction of Toxicity, Mobility, or Volume through Treatment

This evaluation addresses the statutory preference for selecting remedial actions that employ treatment technologies which permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. This preference is satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminant mobility, toxicity or reduction of total volume of contaminated media.

By providing for extraction of portions of the contaminated aquifer which may not be satisfactorily addressed by the implementation of the Operable Unit 1, contaminant mobility can be substantially curtailed by alternative 3b and 3c. While extraction rates and well locations are best left to design phases of this project coupled with operating experience yielding enhanced aquifer response information, up to 400 gallons per minute of contaminated groundwater may be extracted if alternative 3c is undertaken. Alternatives 3a, 3b and 3c also allow for reduction of toxicity of groundwater contaminants via physical-chemical and aerobic biological treatments. In summary,

alternatives 3a, 3b,and 3c would provide reduction in contaminant toxicity and mobility and are clearly superior to alternative 1 or 2 which do not offer such capability; no alternative would have a pronounced effect on contaminant volume.

Short-term Effectiveness

Short-term effectiveness considers the time needed to achieve protection against any adverse impacts on human health and the environment that may be posed during the alternative's construction and implementation period until remedial clean-up goals are achieved. Important factors to consider to evaluate the short-term effectiveness of each alternative are protection of the community during remedial action, protection of site workers during remedial action, and time until remedial objectives are met.

Alternatives 2, 3a, 3b, and 3c may require the installation of groundwater monitoring wells to complement existing wells at the site. Such installation can be accomplished within a relatively short time frame of 4-5 months. Some minimal disturbance to the surrounding community may occur. Various protection measures will require implementation during the construction phase, such as air monitoring for the community and protection gear for site workers.

The activity noted above should cause no more than temporary inconvenience to the local community. Supplements to treatment systems envisioned for Operable Unit 1 may be necessary for alternatives 3a, 3b, and 3c. This may require excavation activity which could result in increased dust generation.

However, both workers and the local community should be protected through proper application of dust suppression techniques. Alternatives 3a, 3b, and 3c should take (respectively) 24, 28,and 24 months for implementation of construction activity.

Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative, and the availability of various services and materials required during the remedy implementation.

All the alternatives can be implemented without significant difficulty concerning availability of extraction and treatment component hardware. Treatability study efforts regarding Operable Unit 1 will provide important design information for the treatment system. U.S. EPA cannot judge precisely the degree of cooperation that may be given by various property owners over the area of contamination. Consequently, there may be some difficulty in gaining access from property owners to install the

extraction system.

In considering the three active restoration approaches, alternative 3a is likely the easiest to implement. This is because it addresses only restoration of the shallow portion of the aquifer. Alternative 3c poses a moderate challenge. It attempts to address both shallow and deeper zones of the aquifer, which is a more complex design consideration. However, because 3c envisions a phased approach to well installation, any refinement to the system should be taken in an informed manner. Alternative 3b, which does not envision a phased approach, would likely prove the most difficult to implement.

Cost

This criterion assesses the cost effectiveness of the alternatives. The projected present-worth cost of Alternative 3a is approximately $26,000,000. Alternative 3b has a present worth

cost of approximately $40,300,000, which is the highest cost alternative. Alterntive (3c) has a present-worth cost of $26,000,000.

Alternatives 3a and 3c are estimated to cost $26,000,000 in terms of present net worth for installation of new monitoring wells, data gathering efforts regarding future pollutant migration trends, installation of extraction wells, associated conveyance and treatment, and operation-maintenance of such devices. Alternative 3b has a present net worth of $40,000,000 for these same tasks. Costs are predicated to a large degree on design and future operating experience. While a precise number and location of extraction wells cannot be projected at this time, design should consider those segments of the aquifer that cannot be satisfactorily addressed by Operable Unit 1.

In terms of initial capital cost, alternative 3c is most advantageous. For approximately the same cost, it addresses both shallow and deep zones of the aquifer; whereas alternative 3a addresses only the shallower area. In terms of capital, operation/maintenance, and present net worth, alternative 3c is superior to alternative 3b which also envisions addressing shallow and deep aquifer zones.

Alternative 1 and 2 have far lower costs than 3a, 3b, or 3c. However, alternatives 1 and 2 are not protective of human health and the environment, and therefore cost comparisons are not meaningful between such subsets of alternatives.

State Acceptance

This criterion has been explored more fully in comments the State

of Michigan made regarding the Proposed Plan. As noted in the transcript of the public meeting, the State of Michigan indicated concurrence on the approach recommended in the Proposed Plan.

Community Acceptance

The issues of community acceptance will be addressed more fully in the Responsiveness Summary developed for this operable unit. If comment from Operable Unit 1 can be used as a guide, the citizens who live in the vicinity of the site will favor aggressive groundwater restoration efforts. PRP comments on the Operable Unit 1 were highly negative; such comments can be expected again for any measures beyond institutional control or no-action.

9. Selected Remedy

Before noting the major components and costs of the selected remedy, it is appropriate to discuss remediation goals for groundwater at the site. The goal of this remedial action is to restore all portions of the aquifer so that it may serve as a drinking water resource. Some studies suggest, however, that not all groundwater extraction and treatment programs are completely successful in reducing contaminant concentrations to health-based levels throughout an aquifer. U.S. EPA therefore recognizes that review of future operating data may indicate the technical impracticability of attaining health-based groundwater quality standards throughout the aquifer. If, at any of the subsequent five-year reviews, it becomes apparent that unsatisfactory progress is being made in attaining groundwater goals, the remedy may be reevaluated. If the remedy is reevaluated, any change in remedy shall be accomplished through reopening and amendment of the ROD, to include an explanation and documentation of all findings, in accordance with 42 U.S.C. 9261(d)(4), and 9617. The following list notes higher levels of certain hazardous substances detected in the aquifer below and downgradient of the Ott/Story/Cordova site, maximum contaminant levels (MCLs) associated with certain hazardous substances, Integrated Risk Information Systems (IRIS) concentrations that represent a 1X10-6 cancer risk for certain carcinogenic substances, to be considered levels, and proposed Michigan Act 307 cleanup standards which represent a "Type B" cleanup response. (See table on following page.)

It should be noted that monitoring well W3 located upgradient of the site showed no detectable volatile organic contaminants or pesticide fractions, and for semivolatiles revealed only two phthalate compounds at low part per billion levels.

As the table indicates, there are several hazardous substances within the aquifer system at the site that demonstrate carcinogenic behavior. Consequently, achieving MCLs may not be

Ott/Story/Cordova
Groundwater Cleanup Goals
(micrograms per liter)

SUBSTANCE	RI FINDING	MCL	CONC. AT 1 x 10-6	TBC NATL PRIMARY	MICH. 307 TYPE B
Benzene	3800	5	1		1
Chlorobenzene	110			60	100
Chloroform	1900		0.19		
1,2-Dichlorobenzene	2700			600	10
1,4-Dichlorobenzene	74				1.5
1,2-Dichloroethane	110000	5	0.4		0.4
1,1-Dichloroethene	7900	7	0.06		0.06
1,2-Dichloroethene (total cis/trans)	810			70(cis) 100(trans)	100
Ethylbenzene	2100			700	30
Heptachlor	0.15		0.008	0.0004	0.004
Heptachlor Epoxide	0.49		0.004	0.0002	0.004
n-Nitroso-diphenylamine	46		7		
Tetrachloro-ethene	24000			5	0.7
Toluene	93000			2000	40
1,1,1-Tri-chloroethane	3100				200
Trichloroethene	110	5	3		3
Vinyl Chloride	130000	2	0.015		0.02
Xylene(s)	12000				20

where MCL= Maximum Contaminant Level as per Safe Drinking Water Act
TBC= To-Be-Considered as a National Primary Drinking Water Regulation
1 x 10-6= level noted in Integrated Risk Information System

MICHIGAN LIMITS ON STREAM DISCHARGE (Act 245, Part 21; Rule 57) for paramaters to be treated and discharged from the Ott/Story/ Cordova site. Alternative discharge sites are located on Little Bear Creek or the N. Branch Muskegon River at a discharge rate of 0.57 MGD.

Parameters	BAT Limits	Rule 57(2)	LBCrk.	NBrMR
vinyl chloride	3	3.1	BAT	BAT
1,1-DCE	2	2.6	BAT	BAT
benzene	5	60	BAT	BAT
toluene	5	100	225	10327
chloroform		43	BAT	BAT
meth. chloride		59	BAT	BAT
1,2-DCA	10	560	1260	BAT
chlorobenzene		71	160	7332
MIBK		1155	2599	119280
acetone		500	1125	51636
benzyl alcohol		44	99	4544
4-meth. phenol		3	7	310
2-chlorophenol		10	22	1033
2-ethylaniline		27	61	2789
4-chloroaniline		5	11	516
tetraethyl urea		533	1199	27788
camphor		60	135	6196
benzoic acid		208	468	21481
THF		11	25	1136
bis (2-ethylhexyl) phthalate		100	BAT	BAT
arsenic		184	241	4863
cadmium		0.7	0.9	18
chromium		93	121	2435
copper		40	51	977
cyanide A		4	5	106
lead		10	11	130
nickel		148	191	3666
selenium		22	29	585
zinc		177	229	4435

Note:
- all units above are expressed in terms of micrograms per liter
- "BAT" refers to best available treatment

sufficiently protective. Achieving a concentration of contaminant that would yield no more than a 1X10-6 cancer risk for any individual carcinogen is therefore a desirable cleanup level for any substance which exhibits carcinogenic behavior. Since there are several carcinogenic substances in the groundwater, total cumulative carcinogenic risk due to ingestion would be approximately 2X10-5. The cleanup goal is the more stringent value listed for a given contaminant in the following table.

Based on the remediation goals, the selected remedy for Operable Unit 2 at the OTT/STORY/CORDOVA site is alternative 3c for groundwater restoration. In keeping with recent guidance, U.S. EPA believes it may be advisable to consider the phased installation of extraction wells based on knowledge gained of aquifer response. It is not known at this time whether such additonal installation will be necessary, nor how many years into the future such a step may be taken. Some changes may be made to the remedy as a result of remedial design and construction processes.

10. Statutory Determinations

Protection of Human Health and the Environment

The aquifer system below and down gradient of the OTT/STORY/CORDOVA site has been severely degraded through the introduction of contaminants associated with former material or product usage activity at the site. At least a portion of the aquifer in question can no longer serve as a source of residential and industrial water supply, which it once did. At several locations within the aquifer, cancer risks in excess of 1X10-1 would be encountered by a potential groundwater user.

The selected remedy protects human health and the environment with regard to contaminated groundwater. For groundwater, extraction of contaminated groundwater, treatment utilizing physical-oxidation, adsorption, and filtration will assist in reducing contaminant levels. Monitoring and institutional controls will assist in evaluating effectiveness of restoration measures.

Implementation of the groundwater remedy will not pose unacceptable short-term risks or cross-media impacts. With regard to groundwater, the goal of the selected remedy is to restore levels of risk to potential users of the aquifer to 10-6 for a given carcinogen, such that cumulative risk is below 10-4. If this goal proves unattainable, then a possible future goal is containment of groundwater contamination, and the avoidance of pollution of downgradient aquifer portions not now known to be affected.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The groundwater selected remedy is required to fully comply with all federal and more stringent state ARARs unless a waiver is invoked. The selected remedy complies with all ARARs. With regard to groundwater, the selected remedy has as its goal the attainment of all ARARs concerning degree of restoration in conformance with CERCLA Section 121.

Cost Effectiveness

The selected remedy for groundwater affords overall effectiveness proportionate to its cost. The groundwater remedy does promote aquifer restoration. Alternative 3c affords a high degree of effectiveness by promoting restoration in both shallow and deep zones of the aquifer, monitoring restoration progress, and providing information on how the system can/should be refined in the future to meet remediation goals. Alternative 3c is the least costly alternative that addresses both zones of the aquifer.

Utilization of Permanent Solutions to the Maximum Extent Practicable

The groundwater remedy selected provides the best balance of tradeoffs among the alternatives considered with respect to the nine evaluation criteria. The remedies selected also utilize permanent solutions and treatment technologies to the maximum extent practicable for the OTT/STORY/CORDOVA site in conformance with CERCLA Section 121. Beyond the criteria of protection and ARARs compliance, the selected remedy had the best overall balance of long term effectiveness and permanence, reduction of hazardous substance toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost. For groundwater, a remedy invoking active restoration attempt through extraction and treatment is clearly superior with regard to reduction of substance toxicity, mobility, or volume and long-term effectiveness.

The State of Michigan has been consulted during development of the site feasibility study, proposed plan, and participated in the public comment period.

Community views were solicited during the public comment period. The U.S. EPA attempted to keep the community informed of site developments via the local information repositories and by the local establishment of certain documents in the administrative record for this site prior to the commencement of the public comment period.

Preference for Treatment as a Principal Element

By providing treatment for contaminated groundwater collected by extraction wells the selected remedy fulfills the statutory preference for treatment as a principal element. Utilization of such treatment will assist in the destruction of various site pollutants.

11. Documentation of Significant Changes

The U.S. EPA has reviewed and responded to all significant comments received from interested parties during the public comment period. Comments were made on the alternative indicated as preferred in the Proposed Plan as well as other alternatives. Based on review of these comments, the U.S. EPA has determined that there is no need for any significant change to the selected alternative, 3c. In the event that additional data or information during the design of the remedy reveals the need for modification, U.S. EPA will notify the public of any changes to the remedy presented here in this Record of Decision in accordance with applicable law and Agency guidance.